Newsletter

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FRAME

Fast Ramp Up and Adaptive Manufacturing Environment

Inside this Issue

Welcome to the first newsletter...

...of the FRAME project, aimed to keep you up to date on project progress and industrial impact.

Launched in October 2009, FRAME is an European Framework 7 project, aimed on a paradigm shift from the conventional human-driven ramp-up and system integration process to **fully automated, self-learning and self-aware production systems**. So far the project is achieving its objectives and initial results prove promising. The project partners are currently preparing for the Mid Term review and look forward to conducting the first industrial tests on the project demonstrators.

The FRAME project welcomes any external interest and looks forward to keeping you up to date on the progress.

Editorial: Introduction to FRAME

One of the key production processes in high labour cost areas, such as Europe, is the **assembly** of final products.

In particular, the **automotive, aerospace, pharmaceutical** and **medical** sectors require systems that can be installed, meet and maintain target production volumes and be reconfigured quickly and with minimum cost.

The **FRAME Vision** is to create a new solution for highly adaptive, self-aware systems, which will use automated self learning, dynamic knowledge sharing, integrated sensor networks, and innovative human-machine interactions.

The assembly systems will be enhanced with sensor capabilities that feed real-time data into a human-centred self-learning environment, achieving comprehensive self awareness.

The overall system performance will be monitored against production objectives, thus **sub-optimal** behaviour can be identified and rectified.

Further more, methods will be developed to **fine tune** system behaviour based on previously gained knowledge, thereby enhancing ramp-up and system optimisation with self-learning capabilities.

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FRAME Architecture

The project vision and planned FRAME components are underpinned by the implementation of a robust software development plan which has been fully prescribed in consultation with the industrial partners and led by Fraunhofer IPA. The FRAME architecture clearly **identifies** the **constraints, scope and functionality** which should be considered by all project partners during the development of the individual FRAME thematic areas (e.g. self-awareness, HMI, time-to-event transformation).

In order to meet the increased requirement for a formalised software development process, the FRAME architecture team proposed an **iterative cyclic process.**

Following a complete cycle, the individual FRAME components are integrated at Stage Workshops and validated against an industrial scenario before progressing to the next iteration.

Bosch Demonstrator: Two dedicated desk-top modules

Mikron G05 Demonstrator Cell: Designed & equipped with four processes

Rolls Royce Demonstrator: Fully mounted Trent engine

FRAME Demonstrators

Common Approach

The three industrial partners of the project (Bosch, Mikron and Rolls Royce) have each proposed a test case. A common **system life cycle** comprising the phases design, development, build, production and end, has been identified. It is expected that FRAME will enable lead-time to be reduced during the system build phase and ramp-up reduced during the production phase.

A common evolution of the **Overall Equipment Effectiveness** (OEE) within this lifecycle has been defined. The OEE remains at zero until the commencement of the build phase. A maximum value is achieved upon completion of the Factory Acceptance Testing (FAT) and Site Acceptance Testing (SAT).

Three ramp-up scenarios have been identified in the system life cycle phases. These are related to the OEE:

1) Build phase at the manufacturer's site.
2) Installation at the customer's site.
3) Production phase at the customer's site due to failures or reconfiguration.

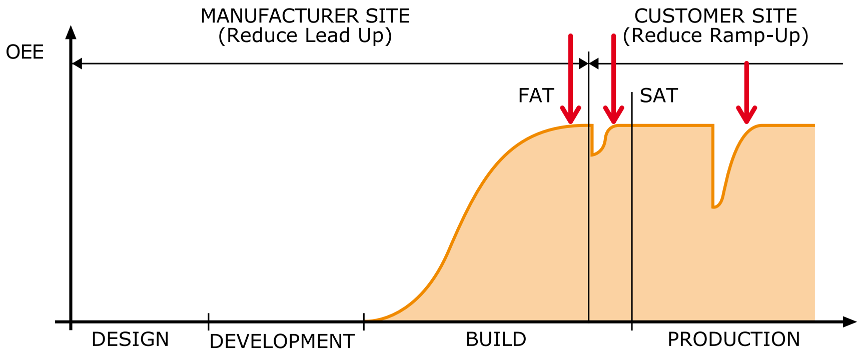
The overall aim is to achieve the maximum OEE possible, through decreasing both the lead-time to market and ramp-up during production.

Demonstrators

The **Bosch** test case is a demonstrator assembly process, representative of a typical **automotive production environment.** It comprises gluing, dispensing and visual inspection modules.

The **Mikron** demonstrator simulates a production environment for **medical devices**. This test case proposes feeding, mounting and inspection processes that represent common steps in the assembly of injection pens.

The **Rolls Royce** test case is product based, and comprises a manual process. Application will be focussed on the sub-assembly of the Trent **aero-engine** High Pressure compressor rotor. The key target is to introduce the FRAME components into the processes involved in the test case, in order to **illustrate** their **feasibility** and **quantify** their **effect**.



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Station Level Self Awareness Achieved

An early focal point of the FRAME project has been the creation of tools that enable the basic self-awareness of assembly stations. Within the FRAME concept, the self-awareness layer provides operational interfaces between human operators, machine performance, and the higher system level. It will also bridge the gap between global system objectives and tangible day-to-day shop floor reality. **The capture of human machine interactions** during ramp-up of individual workstations, it provides the basis, together with sensory data from the machines, to enable stations to learn about their own ramp-up behaviour and to become self-aware. This will allow the stations to proactively engage with shop floor personal to reduce their ramp-up effort. It is therefore fundamental that the FRAME system will have access to as much station data as possible. This requires the extension of the existing sensory capabilities economically and with technical and social feasibility.

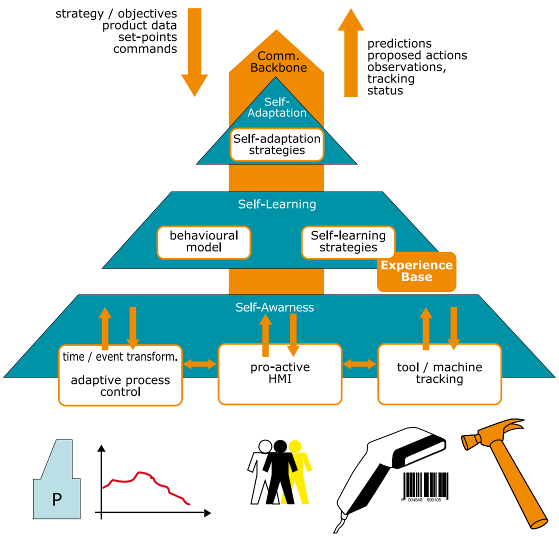
Achievements

A set of generic event types have been defined which enable structured information capture. This is then made available to the self-learning and self-adaptation elements within a station and to the higher system level which coordinates the ramp-up between individual stations.

To date, **two successful integration workshops** have been held to validate the **self-awareness** layer of the FRAME station level. The underlying communication protocols for event broadcasting and querying have been successfully tested and integrated into all FRAME components. A common semantic model has been developed which governs the semantic consistency of FRAME events.

HMIs for the capture of manual hardware and software adjustments have been defined as well as barcode reader based support tools for the identification of adjustment parameters and version control interrogation methods to identify software changes have been created. In addition, the first prototypes of the self-learning core have been developed focussed initially on the capture and structuring of the most relevant ramp-up experience from the stream of events generated by the self-awareness layer. Also **the first components for the system level coordination** layer have been created focusing on the interaction between station level and system level.

Initial results from testing these tools **within an artificial ramp-up scenario are very promising**. This has enabled the project to move ahead with integrating these components into the demonstrator system for close to **real life testing in the next stage.**



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FRAME Consortium

The FRAME Consortium is composed of 10 member organisations from 5 countries, bringing together academic partners, independent research institutes, large industrial companies and SMEs.

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